Interdisciplinary Integration of Courses – Automation and Quality Control

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Manufacturing competitiveness drives production at the lowest cost, highest quality in the least amount of time. This spawns the necessity for streamlined processes from design to planning to manufacturing. Engineers with working knowledge of multi-disciplinary topics, who are strong team workers and leaders are needed. Graduates are not prepared for this environment. Current college education systems deliver courses as disjoint units. They learn the course topics, but seldom see how it is related to other fields. A new philosophy and novel approach to integrating students' learning and knowledge retained is presented. The authors and a Mechanical Engineering professor, Jackie El-Sayed at Kettering have established an ***integration template*** and piloted a method in integrating courses from different disciplines where students from two different classes do a common project.

At Kettering, Robotics and CNC machining are covered in the **Automation** course in manufacturing engineering. Students design and manufacture workparts, they also design the process for making the parts. Though quality control is discussed in class, traditionally, quality metrics are not physically measured and analyzed in this course. In the **Design of Experiments** (DOE), IE course, students learn from textbook and paper-and-pen, to design experiments for measuring quality metrics. They learn how to analyze the data collected through the use of computer software. They do not have physical data to verify their theoretical conjectures.

This paper studies the results and effects of implementing the ***integration template*** to these courses. The requirement is that the two courses have at least one common hour per week to initiate, design, develop, and implement a common project. **Automation** students first learn about CNC and the parameters that affect workpart surface finish quality. **DOE** students first learn about how to design experimentation for measuring and analyzing quality. During the first two common lectures, they formally present and share with the other students their acquired respective knowledge.

In the ensuing common hours, they form interdisciplinary teams to design a product and its manufacturing process(es) (in this case using the CNC), determining which are quality metrics (e.g. surface finish), what parameters affect the metrics (e.g. spindle speed constant revolution per minute or constant surface removal rate, feedrate and tool quality), the amount of variation (e.g. the incremental changes), and the frequency of measurement (e.g. minimum statistically significance number of experiments), and the type of quality / DOE technique (e.g. statistical process control or full [or 2^k] factorial DOE). During common hours and outside the classroom, students project manage, brainstorm, design, agree / disagree, manage conflicts, procure material, fabricate workparts, collect data and analyze them. They also write and present a (1) Project proposal, (2) Project interim report, and (3) Project final report. These students truly have a better understanding of other engineers' points of view, their languages, and technical terms. They are more well-rounded in knowledge, they have improved people skills. The full paper will describe the results and implementation of the integration template. Student surveys and assessments will also be summarized. Student reactions have been very positive.

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